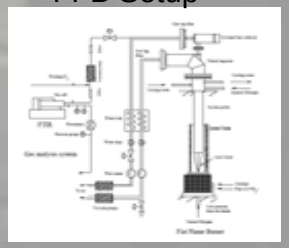
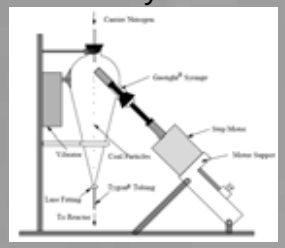
Flat Flame Burner System

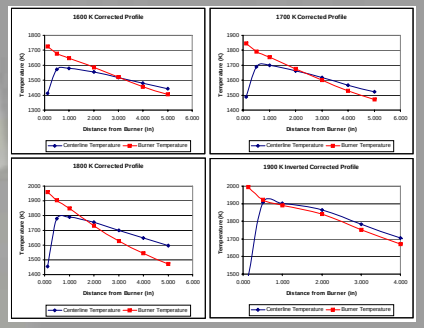
FFB Setup



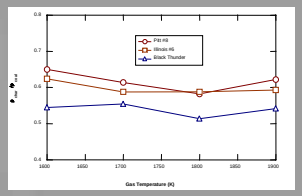
Feed System



Temperature Profiles



- Measured using type B thermocouple
- Readings adjusted for radiation effects.



Char to coal diameter ratio as a function of temperature

FTIR gas cell chamber.
Path length of 10 m

Investigation of Nitrogen Release during Pyrolysis in an Oxycombustion Process

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Objective

- Determine the difference, if any, between mass and nitrogen release in regular air fired and Oxycombustion conditions

Approach

- Replace nitrogen feeds with carbon dioxide feeds in the flat flame burner system
- Perform pyrolysis experiments between 1600 and 1900 K for bituminous and sub-bituminous coals (Black Thunder, Illinois 6, Pittsburgh 8).
- Explain the mechanism for Nitrogen release.
- Mass and nitrogen release calculated using Elemental Tracer Analysis (ETA)
- ETA performed for Si, Ti, and Al
- Individual ETA calculated using equations on left, then averaged
- Results for N_2 environment obtained by Haifeng Zhang (2001)
- CPD = Chemical Percolation Devolatilization

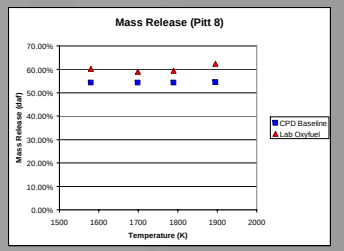
$$\frac{m}{m_o} = \frac{1 - \frac{x_{ele,coal}}{x_{ele,char}}}{1 - \frac{x_{ele,coal}}{x_{ele,ash}}}$$

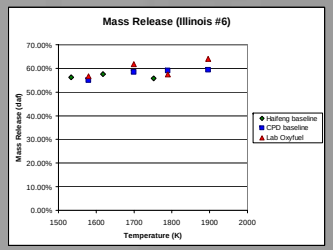
$$\%\ \text{N release (daf)} = 1 - \left(1 - MR_{daf}\right)\left(\frac{x_{N,daf\ char}}{x_{N,daf\ coal}}\right)$$

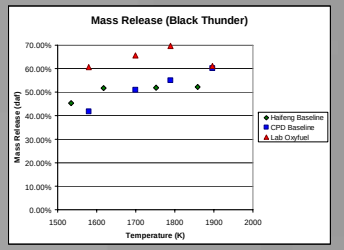
*ele = Element

Results

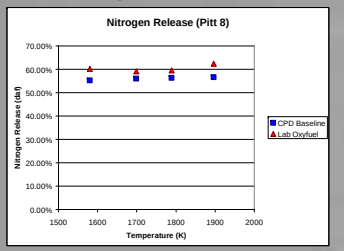
Mass Release

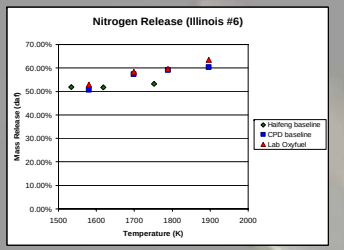


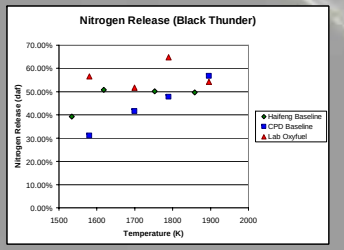




Nitrogen Release







Conclusion

- CPD predicts mass and N release in N_2 environment
- No appreciable difference in mass release or N release observed in oxyfuel condition for the bituminous coals (Ill 6, Pitt 8)
- Increased mass & nitrogen release for sub-bituminous coal (BT) in the oxyfuel environment
- CO_2 gasification possible at these high temperatures

Other Projects

- Predicting Nitrogen Release
  - During Char Oxidation
  - With additives
  - Under Different Residence Times